Credit Growth and Response to Capital Requirements

Evidence from Indian Public Sector Banks

This paper makes an attempt to assess the impact of imposition of uniform capital requirement norm on flow of credit to the business sector by the most important segment of the Indian banking sector, i e, Indian public sector banks. A simple decomposition analysis of growth in assets portfolio as well as a model based analysis of credit growth for the Indian public sector banks corroborated that (a) in the post reform period, public sector banks did shift their portfolio in a way that reduce their capital requirements and (b) adoption of stricter risk management practice in respect of bank lending in the post reform period and its interplay with minimum capital requirements (regulatory pressure) have had a dampening effect on the overall credit supply.

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I Introduction

The regulatory framework for the Indian banking sector underwent a major paradigm shift since the onset of reform process for the Indian economy in 1991. One important component of this new regulatory framework has been the introduction of prudential norms and capital adequacy standards on international lines. It is now well recognised that introduction of capital standards has significantly impacted banking firm's balance sheet and risk taking behaviour. Recognising this the Basle Committee formed a working party to look into the empirical evidence for this impact for banking firms in G-10 countries (BCBS, 1999). Their observation in this regard is worth noting:

> The overall message from the empirical literature and the data is that, at least initially, the introduction of formal minimum capital requirements across the G-10 appears to have induced relatively weakly capitalised institutions to maintain higher capital ratios. At the same time, however, there is some evidence that bank capital pressures during recent cyclical downturns in the US and Japan may have limited bank lending in those periods and contributed to economic weakness in some macroeconomic sectors.

The possibility of a credit crunch through application of minimum capital standards arises because (a) differential risk weights for different asset categories might induce banks to switch away from high risk weighted assets to low risk assets and/or (b) banks might reduce its total assets, for a given capital base, to meet the standards. In either case, the net outcome is that of a reduced credit flow to the business sector. In fact, risk-based capital may be regarded as a regulatory tax that is higher on risky assets. Since it is more costly to raise capital as compared to insured deposits, the banks would have an incentive for substituting out of assets with 100 per cent risk weights like commercial loan into assets with 0 per cent risk weight like government securities. For an emerging economy like India, uncritical adoption of such international standards may compound the problem of resource flow to the business sector in the absence of a well-developed capital market. In this paper, we have attempted to find empirical evidence for the alleged credit crunch that might have been aggravated by the application of capital standards. We have confined our analysis to the Indian public sector banks only, primarily for reason of data availability. As the public sector banks account for more than 75 per cent of total credit flow to the commercial sector, we believe our results have general validity for the Indian banking sector.

The paper is organised as follows: the prescription of capital standards under Basle accord (1988) and their imposition on Indian banks has been discussed in Section II. This section also includes a brief review of some recent studies on capital standard and bank behaviour. As credit growth is envisaged to be intertwined with industrial growth, a brief account of industrial performance in the recent period is also illustrated to provide a backdrop for the main objective of the study. Section III presents briefly the recent trends, especially after liberalisation of financial sector in 1992, in major component, of asset portfolio and capital ratio. Portfolio shifts and the impact of capital ratio on portfolio compositions are discussed analytically in this section. The relationship between capital standard norms and bank's lending behaviour is examined in Section IV with the help of an econometric model. Section V concludes with the major findings.

I Basle Accord on Capital Standards

The widespread criticism about declining capital standards of banks and the consequent bank failures led the Basle Committee on Banking Supervision (BCBS) to announce the adoption of risk-based capital standards. The 1988 Basle Accord requires banks to maintain adequate capital in the form of equity and quasi-equity in a prescribed proportion to their risk weighted asset base. The primary purpose of these standards is to make capital requirements of banks responsive to the risks in the asset portfolio of banks. Prior to adoption of this accord, banks in the G-10 countries were required to keep a certain percentage of their total assets as capital (called leverage requirement),

without any consideration for different risk profile of various categories of assets. The committee on financial sector reforms (Narasimham Committee) recommended introduction of capital adequacy standard for the banks in India on similar lines. Based on these recommendations, RBI introduced a capital to risk-weighted asset system for banks in India since April 1992. According to RBI stipulations, banks were to attain an 8 per cent capital to risk assets ratio (CRAR) within a specified time frame.[1] The time to attain the prescribed ratio was made more stringent for Indian banks with international exposure. In spite of facing some initial problem in meeting the CRAR norms, the Indian public sector banks could, by and large, attain the prescribed CRAR of 8 per cent, with 26 banks having met the norm by 1999.

Capital Standards and Banks' Behaviour – Review of Literature

The impact of introduction of risk-based capital standards has most extensively been studied in respect of US banks. Availability of detailed data for US banks, which are large in number, has helped researchers to undertake such studies. One stylised fact that has been cited by many researchers that a significant shift in the composition of asset portfolio of US banks has taken place since 1989. The shift was towards holding of government securities and away from bank lending. Haubrich and Wachtel (1993) have analysed the quarterly 'call report' data of US commercial banks and concluded that changes in portfolio composition are strongly related to the introduction of risk-based capital requirements. Since banks would be naturally inclined to alter their portfolio structure towards safer assets during an economic downturn, Hall (1993) argued that observed structural changes in banks' asset portfolio could not be fully accounted by the cyclical factors and regulatory changes did impact banks' portfolio behaviour.

Berger and Udell (1994) distinguished two different sets of determinants, representing 'supply side' and 'demand side' factors, respectively, for explaining credit growth. Risk-based capital is included as a supply side determinant of credit growth. They compared the banks' behaviour of 1990-92 to the behaviour of 1980s to account for cyclical factors. They found little evidence of supply side factors in general and risk-based capital in particular, becoming stronger in effect since introduction of capital standards. In a vector auto regression model framework, Hancock, Laing and Wilcox (1995) estimated the dynamic response to capital shocks. They concluded that banks adjust capital ratios much faster than they adjust their loan portfolios. Wall and Peterson (1995) suggested that regulation had a more important impact on bank capital decisions than did market discipline, while Peek and Rosengren (1995) corroborated that formal regulatory action had a significant impact on bank lending decisions, even after controlling for bank capital ratios.

Ediz et al (1998) have studied the impact of capital requirements on UK banks' behaviour. Using a panel data for 94 UK banks stretching from fourth-quarter 1989 to fourth-quarter 1995, they observed that capital requirements did seem to have affected bank behaviour but UK banks adjusted their capital ratios mostly by raising capital rather than systematically substituting away from risky assets like corporate loans. In a recent article, Furfine (2000), using panel data on large US commercial banks during 1989 to 1997, concluded that changes in capital regulation are a necessary ingredient to explain the decline in loan growth.

In the context of Indian banks, Nachane et al (2000) have studied the impact on capital changes of regulatory pressures, conditioning on a host of other variables that are expected to influence capital holding of banks. On the basis of their empirical analysis they concluded that regulatory prescriptions did influence Indian banks' capital ratio choices and they did not observe any significant shift from high-risk towards low-risk asset category by banks.

Brief Overview of Industrial Performance

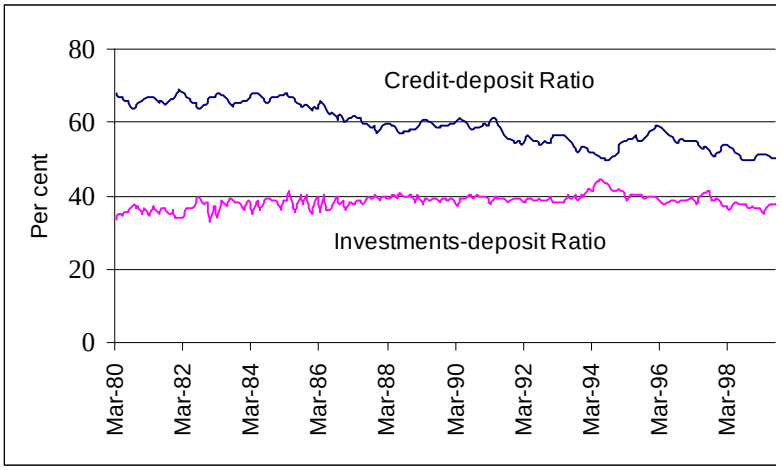
One of the major goals of any reform process is to put the economy on a higher growth trajectory on a sustained basis with moderate to low inflation. Although the Indian reform process has not led to any significant increase in average growth rate of GDP during the decade following the beginning of the reform process, it has also not brought about a precipitate fall in the growth rate as compared to the decade of 1980s. As regards containment of inflation, the reform process has achieved significant success. Despite the fact that there has not been any significant fall in the overall growth rate, the same cannot be said about the performance of the industrial sector, more so about the organised segment of it. The Index of Industrial Production (IIP), which mainly reflects the performance of, organised industrial sector due to its nature of coverage, posted impressive growth rates in the first four years after 1991-92 when it registered a negative growth rate. But since 1995-96,

Table 1: Trends in Various Balance Sheet Compositions, by Size Class – 1992 to 2000

(Per cent)

Variables	Size Class					
	1	2	3	4	5	Total
			Year = 1992			
Deposits/assets	82.31	84.16	85.37	85.95	63.31	82.31
Credit/assets	45.25	53.23	45.97	51.57	46.64	46.70
Investments/assets	32.30	28.94	34.35	23.39	24.68	31.14
NSLR inv/inv	4.79	3.28	14.68	3.27	7.20	5.35
CD Ratio	55.28	63.70	53.81	60.20	73.61	57.15
ID Ratio	39.35	34.28	40.28	27.23	38.99	37.94
			Year = 1995			
Deposits/assets	81.74	81.87	83.94	85.42	81.33	82.06
Credit/assets	40.73	35.48	44.68	37.78	41.97	40.71
Investments/assets	34.39	36.66	32.66	35.38	33.80	34.38
NSLR inv/inv	12.28	12.99	12.16	5.56	15.39	12.67
CD Ratio	50.01	43.38	53.45	44.24	51.80	49.77
ID Ratio	42.09	44.83	38.93	41.42	41.76	41.96
			Year = 1998			
Deposits/assets	81.79	84.17	83.20	90.18	85.12	83.70
Credit/assets	41.33	37.35	35.25	40.44	40.90	39.40
Investments/assets	35.90	40.64	39.57	34.44	34.66	37.12
NSLR inv/inv	15.79	27.29	17.86	13.30	20.11	19.68
CDRatio	50.80	44.41	42.38	44.84	48.30	47.26
ID Ratio	43.78	48.26	47.62	38.19	40.70	44.34
			Year = 2000			
Deposits/assets	79.29	83.34	85.66	83.07	86.05	84.36
Credit/assets	43.30	40.03	37.55	35.09	41.76	39.78
Investments/assets	36.29	39.00	44.71	41.87	35.72	39.40
NSLR inv/inv	18.32	18.06	21.66	28.08	21.32	21.22
CD Ratio	54.63	48.24	44.05	42.23	48.56	47.30
ID Ratio	45.75	47.03	52.22	50.38	41.58	46.79

Graph 1: Ratios* of Resource Mobilisation of Commercial Banks



Note: * Compiled from various issues of Reserve Bank of India Bulletin. Investments include those in approved securities only.

the growth rate of IIP has fallen considerably and remained always at a single digit level. Of many factors that are likely to have contributed in engendering this sluggish industrial performance, liquidity or credit crunch has been cited by many experts as one of the major factors. Bhaumik and Mukhopadhya (1997) have rightly argued that observed trend in credit growth and substitution of risky assets by sovereign debts in banks' asset portfolio cannot be considered as sufficient evidence of a credit crunch leading to industrial recession. The main issue is whether credit growth is explained more by supply side factors or by demand side factors. In this paper we follow a similar approach in isolating the effect of demand side factors from that of supply side factors in explaining credit growth of Indian public sector banks but at a more disaggregated level. Since introduction of capital standards is expected to affect supply side of credit flow, we thereby expect to unravel the macroeconomic impact of such policy prescriptions.

Before we examine this issue within the framework of a suitably articulated model of credit growth, we undertake a descriptive analysis of the relationship between asset portfolio changes and capital requirements at bank level.

II
Trends in Indian Public Sector Banks' Asset Portfolio and CRAR

The composition of 28 public sector commercial bank portfolios has changed significantly in the post reform period. During the decade of 1980s, the C-D ratio of these banks hovered around 60 per cent, which came down to as low as 48.4 per cent by March 1994. After registering a slight increase in next two years, the ratio again came down to 47.8 per cent by the end of March 2000. On the other hand, investment-deposit ratio continued its upward trend from 38 per cent in 1992 to around 47 per cent by end March 2000. The entire banking sector also witnessed the same trend in the last two decades (Graph 1).

Total securities holding of commercial banks expanded rapidly through the 1980s and began to speed up further after 1992 to facilitate the government of India borrowing programmes. The rapid increase in investment-deposit ratio since 1992 has clearly coincided with a substantial decline in credit-deposit ratio. Moreover, the development of active securities and money market and the access to deploy the funds in commercial sectors through commercial papers, stock markets, bonds/debentures also enhanced banks' investments opportunities.

In order to examine the trends in changing composition of major balance sheet items over different size class, the data of 27 public sector banks have been divided by asset size (end March 1992) as follows: 1) less than Rs 10,000 crore; 2) Rs 10,000 crore to Rs 15,000 crore; 3) Rs 15,000 crore to Rs 20,000 crore; 4) Rs 20,000 crore to Rs 25,000 crore and 5) more than Rs 25,000 crore.

The trends in various balance sheet ratios, classified by various size classes since 1992 are presented in Table 1. While deposit share of public sector banks increased in the post reform period, credit share (as a ratio to total assets) declined from 47 per cent in 1992 to 40 per cent in 2000. In contrast, investments share (as a ratio to total assets) increased form 31 per cent in 1992 to 39 per cent in 2000. The shift in portfolio was more prominent for big size banks.

It is interesting to note that the change in credit-deposit ratio during the post reform period was more rapid for big size banks. The medium size banks (size class 3 and 4) in the later period, especially after 1998, noticeably increased their investment-deposit ratio. Public sector banks also used the other investments window, viz, towards non-SLR securities more actively during the post reform period. Thus, public sector banks in the post reform period adjusted their portfolio share in favour of investments for the simple reason that relative to bank credit, investments became more profitable due to its less/no capital standard requirement. These findings, therefore, clearly underscore the need to examine the impact of capital requirements on the shift in portfolio choice.

As in the case of various size classes, public sector banks are classified by four capital classes according to their CRAR as follows: (i) less than 4 per cent; (ii) 4 per cent to 8 per cent (iii) 8 per cent to 12 per cent; and (iv) more than 12 per cent.

While the trends in CRAR, by different size class, are presented in Table 2, the distribution of banks by capital and size class during 1996 to 2000 are presented in Appendix.

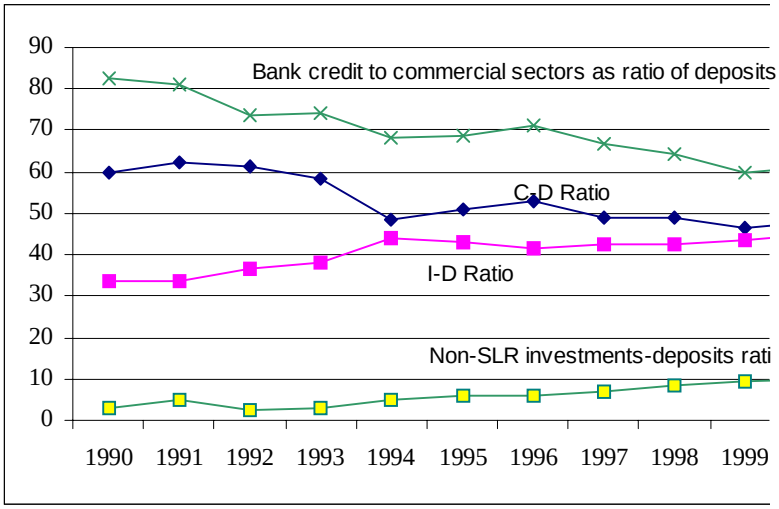
On average, almost in every size class, public sector banks augmented their capital during 1996 to 2000, although there were a few noticeable exceptions. Around two-thirds of public sector banks were found to have CRAR in the range of 8 per cent to 12 per cent. Most smaller public sector banks had high capital ratios. In

Table 2: Trends in CRAR, by Size Class – 1996* to 2000

Year	Size Class					
	1	2	3	4	5	Total
1996	7.91	10.06	2.37	6.07	9.97	7.57
1997	10.40	12.09	0.81	10.53	10.48	9.19
1998	12.11	12.37	8.15	9.34	10.76	11.13
1999	12.31	11.17	11.36	7.34	11.16	10.75
2000	12.41	11.64	11.63	3.42	10.81	10.54

Note: * The data on CRAR are available only from 1996.

Graph 2: Selected Ratios (in per cent) of Public Sector Banks



contrast, a few medium-sized banks were found to be severely undercapitalised.

Capital and Portfolio Shifts

A bank may satisfy capital standards requirement in three ways – through a shift in portfolio, through shrinking total assets or by raising new capital. The observed change in ratio of capital to risk-weighted assets will be a result of interplay of any combination of these three factors. These three factors are termed as portfolio shift, total asset shift and capital shift. The following simple identity brings out the relationship between all the underlying behavioural ratios.

Capital = (capital/risk-weighted assets) × (risk-weighted assets /total assets) × total assets or, $C=R \times P \times TA$ where R = the risk-weighted capital ratio, P = the portfolio factor and C = Capital.

For proportionate changes (e g, $\hat{C} = \frac{\Delta C}{C}$), the relationship works out as follows:

$$\hat{C} = \hat{R} + \hat{P} + \hat{TA} \text{ or}$$
$$\hat{R} = \hat{C} - \hat{P} - \hat{TA}$$

To meet a targeted risk-adjusted capital requirement, a bank has three options, namely, (i) raise capital (increase C), (ii) adjust the portfolio factor (lower P) and (iii) shrink total assets (lower TA).

The adjustment behaviour of Indian public sector banks consequent upon introduction of capital adequacy norms could be studied both at macro as well as micro level. The macro-behaviour is best studied in terms of selected ratios like credit-deposit ratio, credit to commercial sector to total deposit money ratio, etc. These ratios are given in Graph 2.

As mentioned earlier, it is observed that there was a discernible shift towards investments, which comprise mostly government securities. The preference for zero risk weighted assets on the part of commercial banks is also reflected in the fact that the banks are now holding a sizeable amount of government papers, much more than required statutorily. In order to study the impact of capital standards on portfolio behaviour at bank level, we first classify the banks in terms of size and initial capital to risk-weighted ratio on the same lines of Haubrich and Wachtel (1993) study because it is hypothesised that banks with lower CRAR ratio would be more prone to adjust its portfolio to meet higher capital standards. Because of data[2] problems the required decomposition analysis could be undertaken only for two years, viz, for 1999 and 2000. These patterns are set out in Tables 3A and 3B.

During 1999, banks did shift their portfolio in a way that reduced their capital requirements (Table 3A). This shift was more pronounced for either under capitalised banks or over capitalised banks. Banks likewise responded by raising capital by way of injecting fresh capital. Finally, on average, banks did not shrink, and in fact grew over this period in every size and capital class (except for an outlier bank). During 2000, almost in each size and capital category, banks adjusted their portfolio to their capital burden (Table 3B). Well-capitalised banks further raised their capital and at the same time increased their size also. These patterns roughly confirm our emphasis on the portfolio effects on the capital requirements.

To explore the relationship between credit growth and capital requirements, we classified public sector banks by size and capital classes and presented in Table 4. During 1996, undercapitalised banks recorded a very low credit growth as compared to well capitalised banks. Credit growth of public sector banks worsen further in 1997. Alongwith undercapitalised banks, majority of well capitalised banks also recorded a very low credit off-take. Except for four banks, all other public sector banks, irrespective of their size, registered the minimum 8 per cent capital requirement during 1997. It may be mentioned that the year 1997 is marked with noticeable industrial slowdown. From 1998 onwards, the pattern of credit growth is much more systematic: while undercapitalised banks were more risk averse and recorded lower credit growth, bank credit of well capitalised banks continued to grow by a healthy rate, irrespective of their size. However, in general, credit portfolio of small banks

Table 3A: Adjustments to Risk-based Capital Requirements: Portfolio Shifts, Growth and Raising Capital as on March 1999

Capital Class	Size Class				
	1	2	3	4	5
			Portfolio shift $\hat{P}$		
1	-	-	-	-0.13	-
2	-	-	-	-	-
3	0.01	0.03	0.03	0.11	-0.04
4	0.05	-0.02	-0.03	-	-0.02
			Size shift $\hat{TA}$		
1	-	-	-	0.10	-
2	-	-	-	-	-
3	0.17	0.20	0.17	0.13	0.16
4	0.22	0.22	0.27	-	0.19
			Capital shift $\hat{C}$		
1	-	-	-	-7.09	-
2	-	-	-	-	-
3	0.05	0.11	0.21	0.27	0.25
4	0.30	0.12	0.14	-	0.13

grew much faster than big banks and undercapitalised banks were marked with very low credit growth during 1996 to 2000.

IV
Capital Standard Norms and Banks' Lending Behaviour

An Econometric Analysis

The decomposition analysis of banks' balance sheet aggregates given in the earlier section is mainly indicative in nature. It does not explain the causative factors that are responsible for the observed trend in banks' lending to business sectors. For this, we need to formulate a well-articulated behavioural model of banks' lending. For the sake of brevity we will try to capture only the most important factors along with the capital to risk-weighted asset ratio, which is expected to capture the regulatory pressure on banks' lending behaviour.

The observed lending of a bank to commercial sector is postulated to be the result of interplay of two sets of factors, namely, demand factors as well as supply factors. Adopting a disequilibrium framework, the observed credit flow can be modelled in the following way:

$C^o = \text{Min.}(C^d, C^s)$

where superscripts o, d and s stand for observed off take of, demand of and potential supply of credit, respectively. The demand schedule and supply schedule of credit would be modelled as $C^d = f(D)$ and $C^s = f(S)$ where D and S respectively represent an array of demand side variables and supply side variables.

Specification of Demand Schedule

The demand of credit by the commercial sector (i e, the credit demanding sector) is postulated to depend on level of economic activity of the commercial sector, cost of credit, health of the balance sheet of the commercial sector and availability of alternative source of fund, probably at a cheaper rate, for the commercial sector. Let us elaborate more on these variables and specify the actual data elements used in this study to represent these demand variables.

That level of bank credit demanded by an economic agent will be largely determined, in a ceteris paribus way, by the level of economic activity, however measured, undertaken by the agent requires no further explanation. The main issue is that of measurement of that level relevant for individual banks, as we are interested in carrying out our analysis at bank level. First of all, we should note that an aggregate measure of economic activity like GDP or Index of Industrial Production (IIP) may be inadequate, mainly for two reasons. Firstly, for a cross-sectional analysis, this variable would provide no additional information and would be absorbed in the intercept term. Even for a panel data analysis covering a short time duration such a macro-indicator would hardly have any impact on analysis. More importantly, even for a given macro-environment each bank would face a different set of clientele depending on its regional spread, its historical client profile, etc. Based on this consideration, we have constructed a synthetic IIP (SYNIIP) for each bank, taking industrial composition of its own loan portfolio, as available from BSR returns and production index of the respective sectors[3] from the sectorwise IIP.

As a measure of cost of credit, we have calculated the realised rates of return on bank advances. As a measure of availability of alternative source of fund to the borrowers, we use a proxy in the absence of any direct data. We consider the growth in non-SLR investment in the banks' asset portfolio as an indirect indicator of substitution of traditional bank credit by other sources of fund on the part of commercial borrowers. It may be noted here that non-SLR investments that is of direct relevance to our problem is banks' investment in commercial paper issued by corporate entities. As investment in commercial paper of corporate entities is carved out of total credit limit available to the entity from the banking sector, it is presumed that growth in non-SLR investment may be considered as a good proxy measure for the growth in availability of alternative fund to borrowers. As regards the health of the balance sheet of commercial sector, we have taken the ratio of NPA to total advances as an indirect measure of the health of balance sheet of borrowers of bank loan. Obviously, by using this indirect measure, we are ignoring the problem of wilful default. For, willful default may not necessarily result from balance sheet weakness of loans of bank fund.

Specification of Supply Schedule

The supply schedule of credit is postulated to depend on supply of fund to the banking sector in the form of deposit, capital to risk-weighted asset ratio (CRAR), excess of return on advances over that on investment and intermediation spread. A discussion on each of the chosen variable follows.

In India aggregate deposits form the largest amount (around 90 per cent) of funds mobilised by commercial banks. Therefore, deposit growth essentially forms the binding constraint on a bank's ability to extend loans to its borrowers. For public sector banks at least, the growth of deposits is largely exogenously determined and the banks have to find a profitable avenue for the deployment of fund so obtained.

The CRAR is the variable of interest to us in this exercise and is expected to reflect the impact of regulatory norms (pressure) on a bank's lending behaviour.

As there are two major avenues for fund deployment, namely loans and investments, it is expected that excess of returns on loans over investments would affect the supply side of loans made available by banks to its industrial borrowers. Accord-

Table 3B: Adjustments to Risk-based Capital Requirements: Portfolio Shifts, Growth and Raising Capital as on March 2000

Capital Class	Size Class				
	1	2	3	4	5
			Portfolio shift $\hat{P}$		
1	-	-	-	0.03	-
2	-	-	-	-	-
3	-0.04	0.02	-0.01	0.01	0.05
4	-0.01	-0.01	-0.05	-0.01	0.04
			Size shift $\hat{TA}$		
1	-	-	-	0.10	-
2	-	-	-	-	-
3	0.24	0.14	0.17	0.14	0.15
4	0.18	0.18	0.24	0.31	0.12
			Capital shift $\hat{C}$		
1	-	-	-	0.46	-
2	-	-	-	-	-
3	0.20	0.25	0.23	0.08	0.19
4	0.18	0.18	0.29	0.17	0.06

ingly we have included this variable as one of the explanatory variable in the supply schedule of bank loans. Finally, intermediation spread reflects the overall margin received by banks in their deployment of fund and increasing margin should have a positive effect on the supply of bank funds to the borrowers. This variable has, therefore, been considered as an additional determinant of supply of bank fund. Summary statistics of the variables are presented in Table 5.

It is observed that the growth in synthetic IIP (SYNIIP) is higher than that of IIP general for most of the years. Thus the demand for bank credit seems to be growing at a higher rate than the overall demand of the organised sectors of the economy. Over 15 per cent of the gross advances of public sector banks turned out to be non-performing. While deposit growth has been steady in the post reform period, credit growth has been fluctuating. Banks' investments in commercial papers, bonds/debentures/shares of public sector undertakings and private corporate sector, as represented by non-SLR investments, have shown accelerated growth during the post reform period. The excess return of advances over investments has been declining and thus underscoring the importance of alternative avenues of deployment of funds over conventional bank credit. Indeed, during 2000, average return on investments was higher than that on advances. In the face of increased competition from domestic and foreign banks, intermediation spread has also been declining since liberalisation.

Estimation Strategy

We have already noted that observed credit growth for any bank is jointly determined by the demand and supply for credit function. We make the first assumption that the same demand and supply function are applicable to all public sector banks, not an unrealistic assumption given the similarity of ownership structure and regulatory environment for these banks. If it was a priori known whether a particular observation on credit growth belonged to a demand constrained regime or a supply constrained regime then it would be a simple exercise to estimate the relevant coefficients of respective functions. In the absence of such prior knowledge, we adopt the method of switching regression to estimate the coefficients of the two targeted functions. The methodology is briefly explained below.

Let y be the dependent variable, which is credit growth in our case.

Let ith obervation on y be determined one of the following two regimes

$$y_i = \sum_{j=1}^{k} ß_{1j}X_{ji} + u_{1i} = x'_i ß_1 + u_{1i} \quad ...(1)$$

$$y_i = \sum_{j=1}^{k} ß_{2j}X_{ji} + u_{2i} = x'_i ß_2 + u_{2i} \quad ...(2)$$

where x's denote the explanatory variables. The errors, u_{1i} and u_{2i}, are assumed to be normally and independently distributed with zero mean and constant variance. The variance for the first regime is σ_1^2 and for the second regime σ_2^2. The problem is to estimate $ß_1$, $ß_2$, σ_1, and σ_2 without knowing a priori which observations belong to which regime.

We can solve this problem using Goldfeld and Quandt's D-method for switching regression and estimate the parameters efficiently using maximum likelihood method. Assuming that there exists observations on some exogenous variable z such that z determines whether i^{th} observation is generated from one equation or the other we may write

$$y_i = \sum_{j=1}^{k} ß_{1j}X_{ji} + u_{1i} = x'_i ß_1 + u_{1i} \text{ if } pz \le 0 \quad ...(3)$$

$$yi = \sum_{j=1}^{k} ß_{2j}X_{ji} + u_{2i} = x'_i ß_2 + u_{2i} \text{ if } pz > 0 \quad ...(4)$$

where, p is an unknown coefficient to be estimated.

Replacing the unit step function on z with a continuous approximation using the cumulative normal integral, we can have a more practical method that produces consistent estimates of various parameters of interest. For z we consider the synthetic variable defined by excess or shortfall of reserve money growth over aggregate bank credit growth. The underlying logic is as follows. If reserve money grows faster than the bank credit growth, it is more

Table 4: Credit Growth, by Size and Capital Class

(1996 to 2000)

Capital Class	Size Class				
	1	2	3	4	5
			Year: 1996		
1	9.06	1.29	-0.01	14.00	-
2	7.08	-	7.70	-	-
3	15.91	14.89	22.10	21.77	17.56
4	18.27	32.39	-	-	-
			Year: 1997		
1	-	-	-	-7.27	-
2	-	-	-	-	-
3	12.52	4.36	2.36	5.61	8.11
4	15.77	4.59	-	-	4.02
			Year: 1998		
1	-	-	5.76	-	-
2	-	-	-	-	-
3	17.17	17.40	16.62	19.48	16.89
4	11.03	36.02	-	-	19.54
			Year: 1999		
1	-	-	-	3.25	-
2	-	-	-	-	-
3	13.45	20.09	18.03	20.48	15.04
4	12.46	22.76	21.99	-	8.72
			Year: 2000		
1	-	-	-	9.43	-
2	-	-	-	-	-
3	25.53	20.44	18.29	22.63	20.01
4	17.61	17.28	23.46	20.99	15.65

Table 5: Summary Statistics: Mean Values of the Variables

Variables	1996	1997	1998	1999	2000
Credit Growth (CRGR)	14.68	8.26	17.64	17.13	19.69
Growth in Synthetic IIP (SYNIIP)	12.74	10.86	12.09	14.54	10.26
Growth in Non-SLR investments	16.83	63.10	50.85	42.31	17.67
Gross NPA as per cent to gross advances (NPA)	18.12	18.53	17.05	16.35	14.22
Return on advances (RoAD)	12.65	13.87	11.85	11.45	10.95
Deposit Growth (DEGR)	12.27	15.44	18.22	18.99	17.19
CRAR	7.57	9.19	11.13	10.75	10.54
Return on advances – Return on investments (RoAD-RoI)	1.69	3.26	0.76	0.62	-0.03
Intermediation Spread	3.09	3.17	3.03	2.87	2.79
IIP General	13.04	6.09	6.51	3.81	8.17

likely that a situation of easy liquidity prevails in the market and demand constraint is likely to be the binding constraint on an individual bank's credit growth and supply constraint is likely to be the binding one in the opposite case.

Empirical Evidence

Based on the above estimation procedure we have estimated our credit demand and supply schedules using the data described earlier in the paper. The results of our estimation are given in Table 6. For a comparative study and to examine the robustness of the parameter estimate we have reported OLS regression estimate (separately for demand and supply equation) along with switching regression results. It is observed that adjusted R^2 improves significantly when one uses switching regression model as compared with traditional OLS regression. The results are also quite different. One reason for this could be the problem of misspecification in OLS regression model. Thus parameter estimates under OLS regression may be biased and one should not make valid conclusions over demand/supply of bank credit based on OLS estimates.

It can be seen from the demand equation under switching regression model that the factors which affected the credit demand during 1996-2000 are 'growth in non-SLR investments' and average return on advances. On the other hand, the growth in overall economy, particularly in industrial segment of it, as represented by the synthetic IIP, has positive but insignificant impact on the demand of bank credit. The quality of borrowers, as measured by the proxy indicator NPA, does have a negative impact on the demand of bank credit. But the quality of borrowers did not influence credit growth significantly.

Financial sector reforms, initiated during 1991-92, have enhanced commercial banks' opportunity in extending credit facilities to commercial sector by way of non-SLR investments. Bank credit channel ceases to be the only window in extending financing facilities to commercial sector. In the overall risk-return trade off, public sector banks have shown accelerated growth in non-SLR investments in the recent past and more than 10 per cent of their depository resources are diverted towards non-SLR investments. As a result, the demand for bank credit has been significantly affected by the growth in alternative investments opportunities. On the other scenario, cost of fund as represented by return on advances, continued to be another dominant factor determining credit demand in India.

From the supply equation, it is clear that both CRAR and intermediation spread have significant impact on the supply of bank credit in India. While CRAR has a negative effect on credit supply, higher intermediation spread leads to higher supply of bank credit. The regulatory pressure, i e, the expected/potential penalty implied by a breach of the capital requirement, has a significant impact on bank lending in India. Adoption of stricter risk management practice by the commercial banks in the wake of deregulation of lending norms in any respect by the regulators and its interplay with minimum capital requirements (regulatory pressure) have had a dampening effect on the credit supply. Thus, in Indian scenario, capital requirements enforced a risk-averse mind-set on the overall risk-taking appetite of the banks. On the other

Table 6: Non-Linear Regression Estimates of the Parameters
(Dependent variable: Credit growth)

	Estimate	SE	Adj R^2
OLS regression			
i) Demand equation			
Growth in synthetic IIP	-0.042	0.037	0.469
Growth in non-SLR investments	0.018	0.013	
NPA	-0.719*	0.082	
RoAd	-2.682*	0.403	
ii) Supply equation			
Deposit growth	0.641*	0.085	0.573
CRAR	0.013	0.156	
RoAd-RoI	-2.744*	0.337	
Intermediation spread	3.082*	0.960	
Switching regression			
i) Demand equation			
Growth in synthetic IIP	0.032	0.033	0.904
Growth in non-SLR investments	-0.041*	0.012	
NPA	-0.107	0.106	
RoAd	-2.052*	0.726	
ii) Supply equation			
Deposit growth	0.114	0.084	
CRAR	-0.452*	0.175	
RoAd-RoI	-0.583	0.470	
Intermediation spread	2.895*	1.341	
P	0.015*	0.006	

*: Significant at 5 per cent level.

Table 7: Classification of Residual (Predicted-Actual) Credit Growth, by Capital and Size Class

Capital Class	Size Class				
	1	2	3	4	5
			Year=1996		
1	-3.32	-4.05	-3.86	-4.02	-
2	-2.68	-	-3.17	-	-
3	-4.23	-5.71	-2.37	-3.67	-4.60
4	-5.18	-5.41	-	-	-
			Year=1997		
1	-	-	-	5.61	-
2	-	-	-	-	-
3	2.28	0.27	4.83	4.12	2.99
4	1.80	2.51	-	-	5.59
			Year=1998		
1	-	-	1.23	-	-
2	-	-	-	-	-
3	-0.39	1.11	1.43	1.69	1.16
4	1.31	0.08	-	-	1.43
			Year=1999		
1	-	-	-	-2.13	-
2	-	-	-	-	-
3	-1.57	-0.81	-0.46	-0.43	0.09
4	-0.20	-0.58	-1.05	-	0.78
			Year=2000		
1	-	-	-	3.34	-
2	-	-	-	-	-
3	-0.30	0.53	0.50	0.72	0.83
4	1.40	1.61	1.08	1.51	1.05

hand, the impact of deposit growth and the excess return in advances over investments were found to be insignificant.

The residual (predicted-actual) credit growth based on the switching regression model, by various capital and size classes, is presented in Table 7. A negative value of the residual means actual credit growth is higher than the predicted one. By this classification, it is interesting to see that there are two distinct phases of lending behaviour during 1996 to 2000. While actual credit growth was higher for 1996 and 1999, predicted credit growth was much higher in 1997, 1998 and 2000. Since most of the public sector banks have shifted to higher CRAR class in the later years, the excess/shortfall in credit growth based on our model is a clear pointer to the possibility of regulatory pressures acting as a controlling factor in supply of credit to the commercial sector.

V Conclusions

In this paper, we have tried to assess the impact of imposition of uniform capital requirement norm on flow of credit to the business sector by the most important segment of the Indian banking sector, i e, Indian public sector banks. A simple decomposition analysis of growth in assets portfolio as well as a model based analysis of credit growth for the Indian public sector banks have enabled us to conclude the following:

(1) In the post reform period, public sector banks did shift their portfolio in a way that reduce their capital requirements. This was more pronounced for either under-capitalised or overcapitalised banks.

(2) Adoption of stricter risk management practice in respect of bank lending in the post reform period and its interplay with minimum capital requirements (regulatory pressure) have had a dampening effect on the overall credit supply. EPW

Notes

[The views expressed in the paper are those of the authors' only.]

1 The minimum capital ratio has since been raised to 9 per cent, effective from end-March 2000.

2 The data used in this study are taken from various issues of *Statistical Tables Relating to Banks in India* and *Report on Trend and Progress of Banking in India*, Reserve Bank of India.

3 Sectors included in computation of Synthetic IIP are: (1) mining and quarrying, (2) food products, (3) beverages, tobacco and related products, (4) cotton textiles, (5) wool, silk and man-made fibre textiles, (6) jute and other vegetable fibre textiles (except cotton), (7) textile products (including wearing apparel), (8) wood and wood products, furnitures and fixtures, (9) paper and paper products and printing, publishing and allied industries, (10) leather and leather and fur products, (11) basic chemicals and chemical products, (12) rubber, plastic, petroleum and coal products, (13) non-metalic mineral products, (14) basic metal and alloy industries, (15) metal products and parts (except machinery and equipment), (16) machinery and equipment other than transport equipment, (17) transport equipments and parts, (18) other manufacturing industries, and (19) electricity.

Appendix: Distribution of Banks by Capital and Size Class: 1996 to 2000

Capital Class	Size Class					
	1	2	3	4	5	Total
Year = 1996						
1	2	1	1	1	-	5
2	1	-	2	-	-	3
3	9	1	1	1	5	17
4	1	1	-	-	-	2
Total	13	3	4	2	5	27
Year = 1997						
1	-	-	2	-	-	2
2	-	-	-	-	-	-
3	11	2	2	1	5	21
4	2	1	-	-	1	4
Total	13	3	4	1	6	27
Year = 1998						
1	-	-	1	-	-	1
2	-	-	-	-	-	-
3	6	4	3	1	5	19
4	3	2	-	-	2	7
Total	9	6	4	1	7	27
Year = 1999						
1	-	-	-	1	-	1
2	-	-	-	-	-	-
3	1	7	2	3	5	18
4	2	3	1	-	2	8
Total	3	10	3	4	7	27
Year = 2000						
1	-	-	-	1	-	1
2	-	-	-	-	-	-
3	2	3	5	1	8	19
4	1	2	2	1	1	7
Total	3	5	7	3	9	27

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